Status of 100-MeV Low-flux Proton Beam Facility Installation at KOMAC

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1. Introduction

Korea Multi-purpose Accelerator Complex (KOMAC) has been supporting the user beam service using 20-MeV and 100-MeV proton beam facilities after the establishment, and the expansion of the beam facilities has been continuously performed for various research fields. As a result, the beam facility for radioisotope (RI) was constructed in 2015, and another new beam facility for research using 100-MeV low-flux proton beam is under installation from last year.

The 100-MeV low-flux proton beam facility was planned because the many beam users in various research fields, such as space radiation effect, biological radiation effect, and radiation detector, are strongly require the high energy and low-flux proton beam for their stable experiment conditions. Especially, the interest in the radiation effects in space environment is recently increased due to the potential of space industry and the demand of proton radiation testing for space applications are also rapidly increased. However, there was not the suitable domestic facility for radiation testing, so some researchers used the foreign proton beam facility like TRIUMF [1].

In this paper, the installation status of 100-MeV low-flux proton beam line at KOMAC was reported. This new beam facility will be expected to be utilized by many users in academic, industry, and institute after installation.

2. Installation status

100-MeV low-flux proton radiation testing facility consisted of three rooms as target room, process room, and control room. Fig. 1 shows the schematic of 100-MeV low-flux proton beam facility.

2.1 Target room

The experiments for space radiation effect, biological effect and radiation detector will be carried out in this room. The expected parameters of 100-MeV low-flux proton beam irradiated into the room through beam window are presented in Table I. All parameters are defined at sample stage.

The instrumentation for beam control and diagnosis was made and installed in the target room. This instrumentation was composed of beam control modules, beam diagnosis system, sample stage, beam dump, etc.

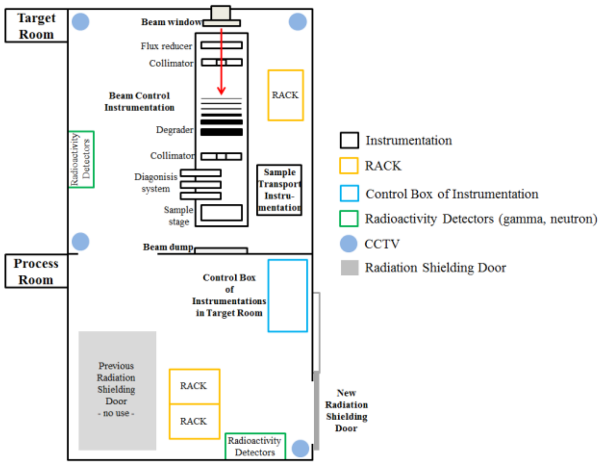

Fig. 1. The schematic of target and process rooms of 100-MeV low-flux proton beam facility.

Table I: Parameters of 100-MeV Low-flux Proton Beam at Sample Stage in Target Room

Parameter	
Energy	33 to 100 MeV
Flux	Max. 10^8 p/cm^2-pulse
Max. average current	8 nA
Areas	Max. 10 cm × 10 cm
Uniformity	< ±5% variation
Shape	Flat
Irradiation conditions	Horizontal, Air

The beam control modules, such as collimator and degrader, is for beam flux and energy control. The beam diagnosis system including 2-dimensional ionization chamber array, transmission monitoring ionization chamber, and farmer chamber from PTW (Germany) is installed for measuring beam profile and real-time beam monitoring. The multi-layer faraday collector from PTC (U.S.A) will be installed for measuring beam energy up to 100-MeV. The beam diagnosis system is under test and the test results will be reported later. The sample stage is possible to move X-Y and rotate 360 degrees. All parts of the instrumentation can be remotely controlled in the control room by LabView-based program. The positioning laser tool is also installed in the target room for alignment. Additionally, the instrumentation for automatic sample transport is installed in side of sample stage, which is compatible

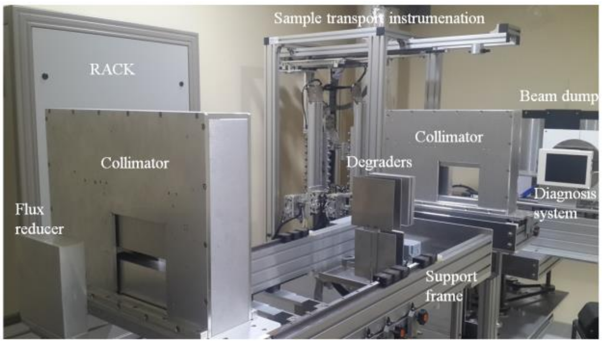

Fig. 2. The installed instrumentation for beam control and automatic sample transport and diagnosis system in target room.

with the beam control instrumentation. Fig. 2 shows the installed instrumentations and diagnosis system in the target room.

2.2 Process room

The data processing and acquisition system was installed in the process room. This system is composed of NIM-based modules, electrometer, DC power supply, computer, and so on. The beam information measured from the diagnosis system and the experimental data from radiation testing electronics/detectors are acquired and analyzed by using this system. The system is connected to the computers in the control room, therefore, the user can easily handle the data without direct approach to the process room.

2.3 Control room

The instrumentations in the target room and the data acquisition system in the process room can be remotely controlled by using computers installed in the control room. And the CCTV and radioactivity monitor of the control and process room were installed to enhance human safety during beam experiments. Fig. 3 shows the picture in control room.

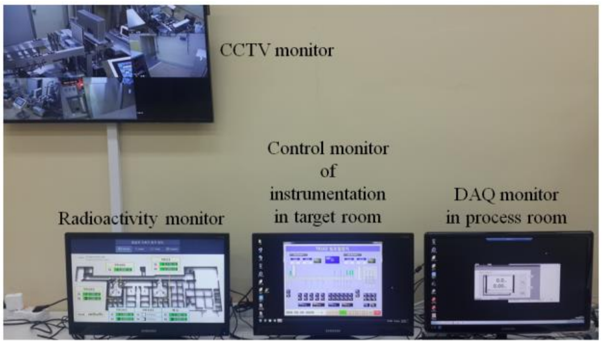

Fig. 3. The installed monitors for the low-flux proton experiments in the control room.

2.4 Radiation safety system

Due to low-flux proton beam, the facility will be keeping the background level of radioactivity during experiments, therefore, the user approach to the target room will be easier and the research efficiency will be improved than those of other high-flux proton beam facility at KOMAC. For easy approach to facility, new radiation shielding door system based on 10 cm-thick high density polyethylene (HDPE) was installed between the process room and control room. The door open/close is automatic and the time for room entry is under 1 minute. To enhance the radiation safety, the radioactivity detectors (gamma and neutron) were installed in the target and process rooms, respectively. In addition, CCTV monitoring system was installed for human safety and the motion sensing signal of each CCTV is connected to the radiation shielding door system, which means that the door is not closed when the user is working in the target or process room.

2.5 Future plan

In the first half of this year, the installation of 100-MeV low-flux proton beam facility will be finished and the facility inspection will be performed. At the same time, the low-flux beam properties will be confirmed using the beam diagnosis system. After the acquisition of radiation safety license from Korea Institute Nuclear Safety (KINS), the pilot user beam service will be started in the second half of this year.

3. Conclusions

The 100-MeV low-flux proton beam facility at KOMAC is installing in order to meet the increasing user's demands for high-energy and low-flux proton radiation tests. The instrumentation for beam control, beam diagnosis system, data acquisition system, and radiation safety system were installed to make user-friendly beam facility and ready to confirm the low-flux beam properties. This new facility will be expected to be utilized by many users in academic, industry, and institute after installation.

ACKNOWLEDGEMENT

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REFERENCE

[1] E. W. Blackmore, Operation of the TRIUMF (20-500 MeV) Proton Irradiation Facility, Proceedings of 2000 IEEE Radiation Effects Data Workshop, pp. 1-5, July 2000.